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ABSTRACT

This unit (which consists of a single lesson) summarizes and reviews most of the solids handling processes in common use in municipal treatment plants. The instructor's guide for the unit includes: (1) an overview of the lesson; (2) lesson plan; (3) lecture outline (keyed to a set of 72 slides); (4) student worksheet (with answers); and (5) two copies of a final quiz (with and without answers). After completing the unit students should be able to briefly describe how each solids handling process works and describe its main function within the solids handling program. In addition, students should become aware of the critical importance of solids handling to the overall operation and effectiveness of the treatment plant. (JN)

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# Biological Treatment Process Control

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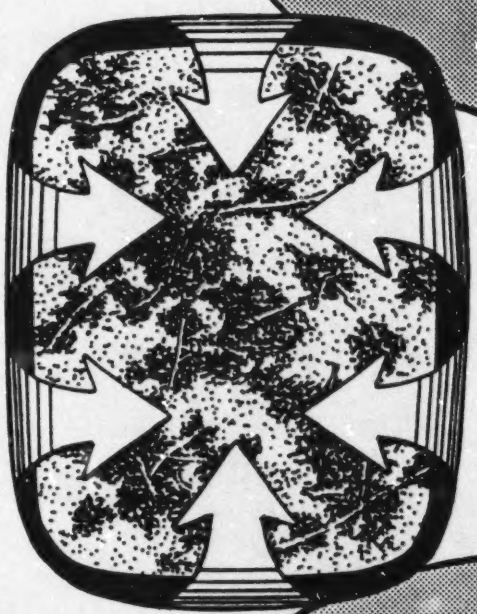
# Review of Solids Handling



## Instructor's Guide

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SE 045 337

Linn-Benton Community College
Albany, Oregon
1984

# BIOLOGICAL TREATMENT PROCESS CONTROL

## REVIEW OF SOLIDS HANDLING

## INSTRUCTOR'S GUIDE

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# REVIEW OF SOLIDS HANDLING

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# REVIEW OF SOLIDS HANDLING

## Overview of The Lesson

This unit is intended to summarize and review most of the solids handling processes in common use in municipal treatment plants. There is no intent to detail the theory and operation of the processes. It is hoped that the student will be able to briefly describe how each process works and what it looks like, and describe its main function within the solids handling program. It is hoped that the student will become aware of the critical importance of solids handling to the overall operation and effectiveness of the treatment plant.

The instructor is encouraged to supplement the visual material with additional slides of systems and processes if it is desirable to emphasize specific topics. Field trips to facilities using specific processes is also recommended.

Valuable demonstration items would include: samples of dried and/or dewatered sludge, samples of filter media, bench top demonstrations of gravity thickening and flotation thickening, demonstration of chemical coagulation (conditioning), demonstration of lime and chlorine stabilization showing increase and decrease of pH respectively, samples of aerobic and anaerobic digested sludge, samples of composted sludge, and samples of incinerator ash.

## Lesson Plan

1. Have students read objectives and if time permits read the text material. (It may be advisable to assign the text material to be read prior to class.)

2. Lecture from outline using slides (72 slides - approximately 45 minute lecture).

3. Assign worksheet (allow about 10 min).

4. Correct and review worksheet (allow 10 - 15 min).
5. Assign final test (allow 15 - 20 min).

# REVIEW OF SOLIDS HANDLING

## Lecture Outline

Slide #'s

#1 & #2 — Title and Credits

Sources of Sludge

- Raw sludge from primary clarifiers
- Biological sludge from secondary treatment
- Chemical sludge from physical chemical treatment

The Importance of Sludge Management

- 0.125 lbs of dried sludge per person per day
- The tail that wags the dog
- A critical component to any treatment system

#3 — Sludge Management

Goals and functions of:

- Volume reduction
- Solids reduction
- Stabilization
- Conditioning
- Ultimate Disposal

A sludge management program can be a combination of these processes

#4 — Volume Reduction

Gravity Thickening

#5

- Similar to sedimentation
- Appearance of basins

| | |
|---|---|
| #6 | Theory of operation |
| #7 | Process components |
| #8 | Description of settled sludge and supernatant |
| #9 & #10 | Flotation Thickening |
| | Appearance of basins |
| | Process components |
| #11 | Theory of operation |
| #12 | Description of float and subnatant |
| | Centrifugation |
| #13 | Theory of operation |
| #14 | Description of equipment and components |
| #15 | Description of cake and supernatant |
| | Belt Filtration |
| #16 | Theory of process |
| #17 | Description of equipment and components |
| #18 | Description of cake and filtrate |
| | Vacuum Filtration |
| #19 | Theory of process |
| #20 & #21 | Description of operation, equipment and components |
| #22 | Description of cake and filtrate |
| | Filter Presses |
| #23 | Theory of Process |
| #24 | Description of operation, equipment, and components |

| | | |
|---|---|---|
| #25 | | Description of cake and pressate |
| | Gravity Concentration | |
| #26 | | Theory of process |
| #27 | | Description of operation, equipment, and components |
| | | Description of cake and filtrate |
| | Drying Beds | |
| #28 | | Theory of process |
| #29 & #30 | | Characteristics of dried sludge |
| #31 | Solids Reduction | |
| | Aerobic Digestion | |
| #32 | | Theory of process |
| #33 & #34 | | Description of basin and equipment |
| | Anaerobic Digestion | |
| #35 | | Theory of process |
| #36, #37, & #38 | | Description of basin, equipment, components |
| | | Gas production and use |
| | Sludge Lagoons | |
| #39 | | Theory of process |
| | | Used for storage and solids reduction |
| #40 | | Description of operation and components |
| | Composting | |
| #41 | | Theory of process |
| #42 & #43 | | Description of equipment, components, and operation |

#44 Description of composted material

Value of composted material

#45 Stabilization

#46 Theory of lime and chlorine stabilization

#47 & #48 Lime stabilization

Description of components and equipment

#49 & #50 Chlorine stabilization

Description of components and equipment

#51 Conditioning

#52 Conditioning used to pretreat sludge for:

Thickeners
Filters
Centrifuges
Drying beds

#53 Conditioning includes chemical conditioning, heat treatment, and elutriation

Chemical conditioning

#54 Theory of coagulation

#55 & #56 Description of components and equipment

Heat Treatment

Theory of heat treatment

#58 & #59 Description of components and equipment

#60 Ultimate Disposal

Final resting place in the environment for treated sludge

| | |
|---|---|
| | Incineration |
| #61 | Theory of process |
| #62 & #63 | Description of equipment, components and operation |
| | Description of gas and ash |
| | Energy requirements |
| | Land Application |
| #64 | Theory of process |
| | Fertilizer value of sludge compared to commercial fertilizer |
| | Application methods |
| #65, #66, #67 | Description of equipment |
| | Landfill |
| #68 | Theory of process |
| #69, #70 & #71 | Description of operation and burying techniques |
| #72 | The Systems Approach |
| | The sludge management system is the final piece of the puzzle required to "see" the whole picture of the total treatment program. |

Answers for Worksheet

1. Which of the following is NOT one of the three major types of solids found in wastewater treatment plants?

   X a. Suspended
   ____ b. Chemical
   ____ c. Raw
   ____ d. Biological

2. Match the following sludge handling processes with their most important function:

| | | | |
|---|---|---|---|
| 4 | a. | Anaerobic Digestion | 1. Conditioning |
| 1 | b. | Elutriation | 2. Stabilization |
| 5 | c. | Landfill | 3. Volume Reduction |
| 3 | d. | Vacuum Filtration | 4. Solids Reduction |
| 1 | e. | Heat Treatment | 5. Ultimate Disposal |
| 4 | f. | Sludge Lagoon | |
| 4 | g. | Composting | |
| 3 | h. | Gravity Thickener | |
| 5 | i. | Land Application | |
| 3 | j. | Belt Filter | |
| 1 | k. | Chemical Treatment | |
| 2 | l. | Lime Addition | |
| 3 | m. | Filter Press | |
| 3 | n. | Flotation Thickener | |
| 5 | o. | Incineration | |
| 3 | p. | Centrifugation | |
| 4 | q. | Aerobic Digestion | |
| 3 | r. | Drying Beds | |
| 2 | s. | Chlorine Addition | |
| 3 | t. | Gravity Concentration | |

3. The "systems approach" to the design of a solids handling system means:

_____ a. That a "systems analyst" using computer based design will always give the best results.

__X__ b. That the solids handling portion must be part of the overall waste treatment system.

_____ c. That with any wastewater plant design, the approaching collection systems are the key issue.

Final Quiz

Multiple Choice: Choose the one best answer and place the corresponding letter in the blank.

1. Which of the following is NOT one of the three major types of solids found in wastewater treatment plants.

   _____ a. Biological
   _____ b. Raw
   _____ c. Chemical
   _____ d. Suspended

2. The pre-treatment of sludge to enhance the effectiveness of volume reduction processes is called

   _____ a. ultimate disposal
   _____ b. stabilization
   _____ c. solids reduction
   _____ d. conditioning
   _____ e. centrifugation

3. Treatment of sludge with lime or chlorine to decrease odor problems and reduce the pathogenic bacteria content is called

   _____ a. conditioning
   _____ b. volume reduction
   _____ c. stabilization
   _____ d. solids reduction
   _____ e. ultimate disposal

4. Solids handling processes that concentrate the solids into dewatered sludge cakes and result in a smaller quantity of sludge is called

   _____ a. solids reduction
   _____ b. volume reduction
   _____ c. conditioning
   _____ d. stabilization
   _____ e. ultimate disposal

5. A volume reduction process in which solids are concentrated by sedimentation in a clarifier-like basin is called

_____ a. flotation thickening
_____ b. belt filtration
_____ c. gravity concentration
_____ d. gravity thickening
_____ e. elutriation

6. The solids handling process that concentrated solids by spinning them like a washing machine is called

_____ a. belt filtration
_____ b. filter press
_____ c. centrifugation
_____ d. vacuum filtration
_____ e. aerobic digestion

7. A volume reduction process in which filter media covers a large drum and in which liquid is pulled into the drum and away from the sludge is called

_____ a. belt filter
_____ b. filter press
_____ c. vacuum filter
_____ d. gravity concentration
_____ e. composting

8. A solids reduction process in which sludge is dewatered by being squeezed between two continuous, porous filters mats is called

_____ a. filter press
_____ b. belt filter
_____ c. vacuum filter
_____ d. centrifugation
_____ e. gravity concentration

9. The process of volume reduction in which water drains away from sludge as well as evaporates is called

_____ a. drying beds
_____ b. incineration
_____ c. gravity concentration
_____ d. aerobic digestion
_____ e. landfill

10. The sludge conditioning process in which sludge is treated with coagulants is called

_____ a. heat treatment
_____ b. lime addition
_____ c. chemical treatment
_____ d. chlorine addition
_____ e. composting

11. The solids reduction process which takes place in large covered tanks, some of which may have covers designed to collect the gas produced during the process, is called

_____ a. anaerobic digestion
_____ b. aerobic digestion
_____ c. composting
_____ d. sludge lagoons
_____ e. elutriation

12. The solids reduction process that is almost the same as the activated sludge process is called

_____ a. anaerobic digestion
_____ b. aerobic digestion
_____ c. composting
_____ d. sludge lagoons
_____ e. flotation thickening

13. The solids reduction process in which sludge is mixed with a bulking agent, spread out in rows and then turned and mixed periodically is called

_____ a. anaerobic digestion
_____ b. aerobic digestion
_____ c. composting
_____ d. sludge lagoons
_____ e. land application

14. The stabilization process whereby the pH of the sludge is raised to about pH 11 is

_____ a. composting
_____ b. sludge lagoons
_____ c. chlorine addition
_____ d. elutriation
_____ e. lime addition

15. The stabilization process in which pathogenic organisms and obnoxious odor are controlled by chemical oxidation is

_____ a. elutriation
_____ b. lime addition
_____ c. chlorine addition
_____ d. incineration
_____ e. heat treatment

16. The conditioning process that is essentially a washing process to remove very fine particles of sludge is called

_____ a. centrifugation
_____ b. belt filtration
_____ c. elutriation
_____ d. heat treatment
_____ e. composting

17. The ultimate disposal method that reduces sludge to inert ash, carbon dioxide, and water vapor is

_____ a. landfill
_____ b. land application
_____ c. vacuum conditioning
_____ d. gravity decomposition
_____ e. incineration

18. The ultimate disposal method in which sludge is sprayed on agriculture land or injected into the soil is called

_____ a. landfill
_____ b. land application
_____ c. incineration
_____ d. sludge lagoons
_____ e. drying beds

REVIEW OF SOLIDS HANDLING

Answers to Final Quiz

Multiple Choice: Choose the one best answer and place the corresponding letter in the blank.

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